TSG-RAN Meeting #19 ***RP-030095***
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Presentation of Specification to TSG or WG

Presentation to:	**TSG RAN Meeting #19**
Document for presentation:	**TR25.895, Version 1.0.0**
Agenda Item:	**9.9.9 "Analysis of Higher Chip Rates for UTRA TDD evolution"**
Presented for:	**Information**

Abstract of document:

The document is TR25.895 v1.0.0 "Analysis of higher chip rates for UTRA TDD evolution". It was agreed at RAN1#31 in Tokyo to present this TR to TSG-RAN#19 for information.

Changes since last presentation to TSG-RAN Meeting #18:

A version of TR25.895 has not previously been presented to TSG-RAN.

The following sections have been completed in the TR :

- Introduction, scope
- Reference higher chip rate configuration
- Link level results for some HSDPA higher chip rate reference radio bearers
- Backward compatibility feasibility
- Link level simulation assumptions
- System level simulation assumptions

Outstanding Issues:

The following issues are outstanding :

- Link level results for R99 bearers and some HSDPA bearers
- System level simulation results
- Link budget
- Complexity analysis
- Feasibility study in section 6 of TR (other than backward compatibility)
- Recommendations and conclusions

Contentious Issues:

-

3GPP TR 25.895 V1.0.0 (2003-03)

Technical Report

3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Analysis of higher chip rates for UTRA TDD evolution; (Release 6)

Keywords
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Contents

Foreword

This Technical Report has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

- x the first digit:
  - 1 presented to TSG for information;
  - 2 presented to TSG for approval;
  - 3 or greater indicates TSG approved document under change control.
- y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.
- z the third digit is incremented when editorial only changes have been incorporated in the document.

Introduction

This technical report presents the results of the 3GPP system Study Item to analyse the use of higher chip rates for UTRA TDD evolution. This study includes an analysis of the feasibility and potential benefits of higher chip rates for UTRA TDD. This study includes a recommendation to RAN Plenary on a potential standardisation work plan and time frame.

Higher chip rate UTRA TDD is studied in the light of the imminent allocation of considerably more spectrum for 3G in bands other than the IMT-2000 band in which systems are currently being deployed, and the demand for higher burst rates and sector throughputs for data traffic in the wide area. Higher chip rate UTRA TDD may be used to support (for instance) personal, multimedia and broadcast services.

Potential benefits of higher chip rate UTRA TDD include system gains from trunking efficiency, link level gains from an ability to better resolve channel paths, the ability to support more accurate location services, higher possible peak bit rates and cell throughputs and an improved ability to reject narrowband interferers.

1 Scope

The present document contains results of an analysis of the feasibility and potential benefits of higher chip rate UTRA TDD.

The analysis in this document is based on a reference configuration at the reference chip rate of 7.68Mcps. The comparison of this reference system with current UTRA TDD releases allows conclusions to be drawn as to the potential benefits and feasibility of even higher chip rates for UTRA TDD.

The document presents results of an analysis of the reference configuration using channel models appropriate to a higher chip rate system. Link level and system level results are presented. A link budget shows the coverage that can be expected at a higher chip rate. Aspects of UE and UTRAN complexity are considered.

The feasibility of higher chip rate UTRA TDD systems is considered. This document covers aspects such as coexistence, backward compatibility, use in diverse spectrum arrangements and allocations, mobility, application to 3GPP system and services, antenna systems and impacts on signalling, specifications and RAN working groups.

The study of higher chip rate UTRA TDD is based on the assumption that the higher layer protocol architecture for higher chip rate UTRA TDD is unchanged from 3GPP Release 5. It is assumed that higher chip rate UTRA TDD shall be evolved from 3.84Mcps TDD and that the higher chip rate UTRA TDD carrier may exist without the need for a supporting 3.84Mcps TDD carrier.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

?? References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.

?? For a specific reference, subsequent revisions do not apply.

?? For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TS 25.301 : “Radio Interface Protocol Architecture (Release 5)”

[2] 3GPP TS 25.401 : “UTRAN Overall Description (Release 5)”

[3] 3GPP TS 25.222 : “Multiplexing and channel coding (Release 5)”

[4] 3GPP TS 25.223 : “Spreading and modulation (Release 5)”

[5] 3GPP TS 25.221 : “Physical channels and mapping of transport channels onto physical channels (TDD) (Release 5)”

[6] 3GPP TS 25.224 : “Physical Layer Procedures (TDD) (Release 5)”

[7] 3GPP TS 25.225 : “Physical layer – Measurements (TDD) (Release 5)”

[8] 3GPP TS 25.102 : “UTRA (UE) TDD; Radio transmission and reception (Release 5)”

[9] 3GPP TS 25.105 : “UTRA (BS) TDD; Radio transmission and reception (Release 5)”

[10] 3GPP TS 25.331 : “Radio resource control (RRC) protocol specification (Release 5)”

3 Definitions, symbols and abbreviations

3.1 Definitions

3.2 Symbols

3.3 Abbreviations

4 Reference Higher Chip Rate Configuration

[Editor's note : This section will describe a reference higher chip rate configuration to enable analysis of feasibility and potential benefits.].

4.1 High Level Architecture

The high level protocol architecture (MAC, RLC, RRC and other protocol elements higher than the MAC layer) for the higher chip rate UTRA TDD reference configuration is unchanged from 3GPP Release 5 as described in 25.301 [1].

UTRAN architecture for the higher chip rate reference configuration is unchanged from 3GPP Release 5 as described in 25.401 [2]. The system elements that are considered in the reference configuration are the RNC, Node B and UE.

The layer 1 architecture for the higher chip rate reference configuration is based on an evolution of the 3.84Mcps TDD architecture. The frame structure, power control procedures, HSDPA aspects etc. are based on those of 3.84Mcps TDD.

The higher chip rate UTRA TDD system does not require the support of a 3.84Mcps TDD carrier (a cell may support only the higher chip rate).

The higher chip rate reference configuration uses a chip rate of 7.68Mcps.

4.2 Radio Aspects

[Editor's note : covers aspects related to the transmit and receive radios (cf RAN4 specifications) – assumed transmit powers, receive sensitivities and bandwidths].

4.3 Layer 1 Aspects

4.3.1 Physical channels and mapping of transport channels onto physical channels

Physical channels

Frame Structure

The higher chip rate reference configuration frame has a duration of 10ms and is subdivided into 15 timeslots (as per 3.84Mcps TDD). Each timeslot is of duration 5120 * T_c and can be allocated to either uplink or downlink.

Spreading for Downlink Physical Channels

Downlink physical channels shall use SF = 32. Multiple parallel physical channels can be used to support higher data rates. These parallel physical channels shall be transmitted using the channelisation codes as defined in section 4.3.3. Operation with a single code with spreading factor 1 is possible for the downlink physical channels.

Spreading for the Uplink Physical Channels

Spreading for uplink physical channels is identical to that of 3.84 Mcps UTRA TDD mode as stated in section 5.2.1.2 of TS 25.221 [5] with the exception that the range of spreading factor that may be used for uplink physical channels shall range from 32 down to 1.

Burst Types

Three burst types are defined : all of them comprise two data fields, a midamble and a guard period, the lengths of which are different for the individual burst types. Thus the number of data symbols in a burst depends upon the spreading factor and burst type as defined in Table 1 below:

Table 1: number of data symbols (N) for burst type 1, 2, and 3

Spreading Factor (SF)	Burst Type 1	Burst Type 2	Burst Type 3
1	3904	4416	3712
2	1952	2208	1856
4	976	1104	928
8	488	552	464
16	244	276	232
32	122	138	116

The support of all three burst types is mandatory for the UE.

Burst Type 1

Burst type 1 can be used for uplink and downlink. The midamble is of length 1024 chips. The maximum number of midambles for burst type 1 shall be 4, 8, or 16. The burst structure of burst type 1 is shown in Figure 1 below:

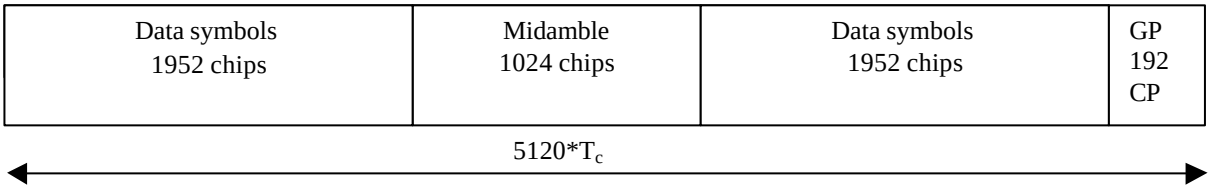

Figure 1: Burst structure of burst type 1. GP denotes the guard period and CP denotes chip periods.

Burst Type 2

Burst type 2 can be used for uplink and downlink. The midamble is of length 512 chips. The maximum number of midambles for burst type 2 shall be 4 or 8. The burst structure of burst type 2 is shown in Figure 2 below:

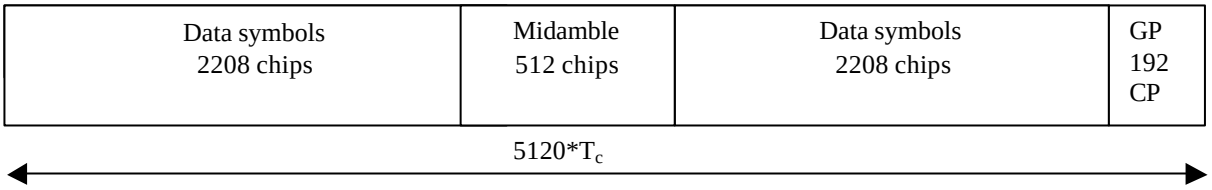

Figure 2: Burst structure of burst type 2. GP denotes the guard period and CP denotes chip periods.

Burst Type 3

Burst type 3 is used in the uplink only. Due to the longer guard period it is suitable for initial access or access to a new cell after handover. The midamble construction is identical to that of burst type 1. The maximum number of midambles for burst type 3 shall be 4, 8, or 16. The second data field is reduced in length compared to the first data field and the structure of burst type 3 is shown in Figure 3 below:

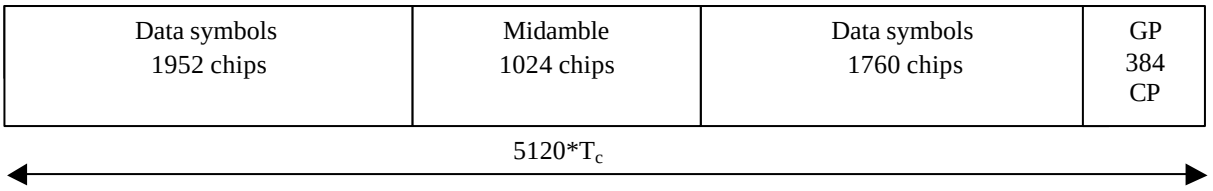

Figure 3: Burst structure of burst type 3. GP denotes the guard period and CP denotes chip periods.

Transmission of TFCI

All burst types 1, 2, and 3 provide the possibility for transmission of TFCI. Transmission of TFCI is identical to that of 3.84 Mcps UTRA TDD mode, see section 5.2.2.4 [5], with the exception that in the uplink the data in the TFCI field are always spread with SF = 32.

Transmission of TPC

All burst types 1, 2, and 3 provide the possibility for transmission of TPC in the uplink. Transmission of TPC is identical to that of 3.84 Mcps UTRA TDD mode, see section 5.2.2.5 [5], with the exception that the data in the TPC field are always spread with SF = 32.

Training sequences for spread bursts

The midamble for burst type 1 or 3 of the reference configuration has a length of Lm=1024, which corresponds to:

K' = 8; W = 114; P = 912.

Depending on the possible delay spread, cells are configured to use K_{Cell} midambles which are generated from the basic midamble codes (which are described below)

- for all k = 1,2,…,K; K = 2K' or
- for k = 1,2,…,K', only, or
- for odd k = 1,3,5,…,? K', only.

The basic midamble codes of length 912 chips are formed from the concatenation of successive basic midamble codes of length P = 456 (as defined in [5]). I.e. the n^{th} base code is formed from the concatenation of the n^{th} and m^{th} existing base codes of length 456, where $m = (n+1) \bmod 128$. The concatenation is pictured below in Figure 4.

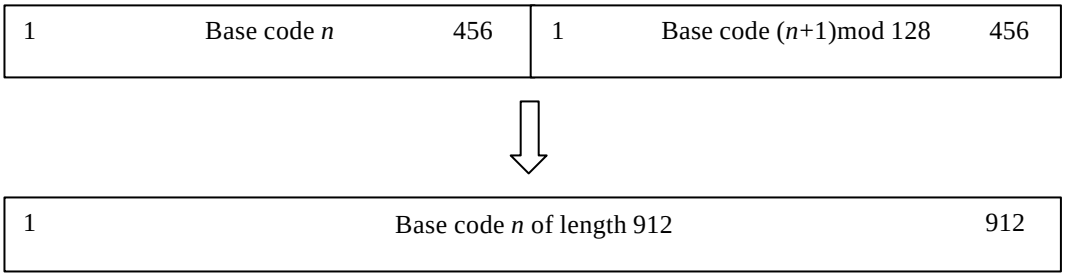

Figure 4: Basic midamble code construction from existing codes of length 456 for burst types 1 and 3.

The basic midamble codes for burst type 2 of the reference configuration are identical to those of burst type 1/3 at 3.84 Mcps as given in Table A-1 of [5]. The maximum number of midambles for burst type 2 shall be 4 or 8 and the midambles are constructed from the basic midamble codes as described in Section 5.2.3 of [5] with the following parameters: Lm = 512; K' = 8; W = 57; P = 456.

Common physical channels

The association between burst type number and physical channels is identical to that of 3.84 Mcps UTRA TDD [5]. All physical channels with the exception of SCH shall be capable of using spreading factor 32. The uplink PRACH uses either spreading factor SF = 32 or SF = 16.

Transmit Diversity for DL Physical Channels

The transmit diversity schemes that may be applied in the reference configuration are identical to those of 3.84Mcps UTRA TDD (sec. 5.4 of [5]).

Beacon characteristics of physical channels

The beacon characteristics of physical channels of the higher chip rate reference configuration shall be identical to those of 3.84Mcps UTRA TDD (sec 5.5 of [5]) with the exception that the beacon channel shall be provided by the physical channel that is allocated to channelisation code $C_{Q?32}^{(k?1)}$.

Midamble Transmit Power

The midamble transmit power of the higher chip rate reference configuration shall be identical to that of 3.84Mcps UTRA TDD (normative part of sec 5.7 of [5]).

Midamble Allocation for Physical Channels

Midamble allocation for physical channels of the higher chip rate reference configuration shall be identical to that of 3.84Mcps UTRA TDD (sec 5.6 of [5]) with the exception that the association between midambles and channelisation codes is as described below :

- Association between Midambles and Channelisation Codes:

The following mapping schemes (defined in Figure 5, Figure 6 and Figure 7) apply for the association between midambles and channelisation codes if no midamble is allocated by higher layers. Secondary channelisation codes are marked with a *. These associations apply both for UL and DL.

-- Association for Burst Type 1/3 and K_{Cell} = 16 Midambles

$\mathbf{m}^{(1)} - \mathbf{c}_1^{(1)}$	$\mathbf{m}^{(1)} - \mathbf{c}_2^{(1)}$	$\mathbf{m}^{(1)} - \mathbf{c}_4^{(1)}$	$\mathbf{m}^{(1)} - \mathbf{c}_8^{(1)}$	$\mathbf{m}^{(1)} - \mathbf{c}_{16}^{(1)}$	$\mathbf{m}^{(1)} - \mathbf{c}_{32}^{(1)}$
					$\mathbf{m}^{(1)} - \mathbf{c}_{32}^{(2)*}$
				$\mathbf{m}^{(9)} - \mathbf{c}_{16}^{(2)}$	$\mathbf{m}^{(9)} - \mathbf{c}_{32}^{(3)}$
					$\mathbf{m}^{(9)} - \mathbf{c}_{32}^{(4)*}$
			$\mathbf{m}^{(2)} - \mathbf{c}_8^{(2)}$	$\mathbf{m}^{(2)} - \mathbf{c}_{16}^{(3)}$	$\mathbf{m}^{(2)} - \mathbf{c}_{32}^{(5)}$
					$\mathbf{m}^{(2)} - \mathbf{c}_{32}^{(6)*}$
				$\mathbf{m}^{(10)} - \mathbf{c}_{16}^{(4)}$	$\mathbf{m}^{(10)} - \mathbf{c}_{32}^{(7)}$
					$\mathbf{m}^{(10)} - \mathbf{c}_{32}^{(8)*}$
		$\mathbf{m}^{(3)} - \mathbf{c}_4^{(2)}$	$\mathbf{m}^{(3)} - \mathbf{c}_8^{(3)}$	$\mathbf{m}^{(3)} - \mathbf{c}_{16}^{(5)}$	$\mathbf{m}^{(3)} - \mathbf{c}_{32}^{(9)}$
					$\mathbf{m}^{(3)} - \mathbf{c}_{32}^{(10)*}$
				$\mathbf{m}^{(11)} - \mathbf{c}_{16}^{(6)}$	$\mathbf{m}^{(11)} - \mathbf{c}_{32}^{(11)}$
					$\mathbf{m}^{(11)} - \mathbf{c}_{32}^{(12)*}$
			$\mathbf{m}^{(6)} - \mathbf{c}_8^{(4)}$	$\mathbf{m}^{(6)} - \mathbf{c}_{16}^{(7)}$	$\mathbf{m}^{(6)} - \mathbf{c}_{32}^{(13)}$
					$\mathbf{m}^{(6)} - \mathbf{c}_{32}^{(14)*}$
				$\mathbf{m}^{(14)} - \mathbf{c}_{16}^{(8)}$	$\mathbf{m}^{(14)} - \mathbf{c}_{32}^{(15)}$
					$\mathbf{m}^{(14)} - \mathbf{c}_{32}^{(16)*}$
	$\mathbf{m}^{(5)} - \mathbf{c}_2^{(2)}$	$\mathbf{m}^{(5)} - \mathbf{c}_4^{(3)}$	$\mathbf{m}^{(5)} - \mathbf{c}_8^{(5)}$	$\mathbf{m}^{(5)} - \mathbf{c}_{16}^{(9)}$	$\mathbf{m}^{(5)} - \mathbf{c}_{32}^{(17)}$
					$\mathbf{m}^{(5)} - \mathbf{c}_{32}^{(18)*}$
				$\mathbf{m}^{(13)} - \mathbf{c}_{16}^{(10)}$	$\mathbf{m}^{(13)} - \mathbf{c}_{32}^{(19)}$
					$\mathbf{m}^{(13)} - \mathbf{c}_{32}^{(20)*}$
			$\mathbf{m}^{(4)} - \mathbf{c}_8^{(6)}$	$\mathbf{m}^{(4)} - \mathbf{c}_{16}^{(11)}$	$\mathbf{m}^{(4)} - \mathbf{c}_{32}^{(21)}$
					$\mathbf{m}^{(4)} - \mathbf{c}_{32}^{(22)*}$
				$\mathbf{m}^{(12)} - \mathbf{c}_{16}^{(12)}$	$\mathbf{m}^{(12)} - \mathbf{c}_{32}^{(23)}$
					$\mathbf{m}^{(12)} - \mathbf{c}_{32}^{(24)*}$
		$\mathbf{m}^{(7)} - \mathbf{c}_4^{(4)}$	$\mathbf{m}^{(7)} - \mathbf{c}_8^{(7)}$	$\mathbf{m}^{(7)} - \mathbf{c}_{16}^{(13)}$	$\mathbf{m}^{(7)} - \mathbf{c}_{32}^{(25)}$
					$\mathbf{m}^{(7)} - \mathbf{c}_{32}^{(26)*}$
				$\mathbf{m}^{(15)} - \mathbf{c}_{16}^{(14)}$	$\mathbf{m}^{(15)} - \mathbf{c}_{32}^{(27)}$
					$\mathbf{m}^{(15)} - \mathbf{c}_{32}^{(28)*}$
			$\mathbf{m}^{(8)} - \mathbf{c}_8^{(8)}$	$\mathbf{m}^{(8)} - \mathbf{c}_{16}^{(15)}$	$\mathbf{m}^{(8)} - \mathbf{c}_{32}^{(29)}$
					$\mathbf{m}^{(8)} - \mathbf{c}_{32}^{(30)*}$
				$\mathbf{m}^{(16)} - \mathbf{c}_{16}^{(16)}$	$\mathbf{m}^{(16)} - \mathbf{c}_{32}^{(31)}$
					$\mathbf{m}^{(16)} - \mathbf{c}_{32}^{(32)*}$

Figure 5 - Association of Midambles to Spreading Codes for Burst Type 1/3 and K_{Cell} = 16

-- Association for Burst Type 1-3 and K_{Cell} = 8 Midambles

$\mathbf{m}^{(1)} - \mathbf{c}_1^{(1)}$	$\mathbf{m}^{(1)} - \mathbf{c}_2^{(1)}$	$\mathbf{m}^{(1)} - \mathbf{c}_4^{(1)}$	$\mathbf{m}^{(1)} - \mathbf{c}_8^{(1)}$	$\mathbf{m}^{(1)} - \mathbf{c}_{16}^{(1)}$	$\mathbf{m}^{(1)} - \mathbf{c}_{32}^{(1)}$
					$\mathbf{m}^{(1)} - \mathbf{c}_{32}^{(2)*}$
				$\mathbf{m}^{(1)} - \mathbf{c}_{16}^{(2)*}$	$\mathbf{m}^{(1)} - \mathbf{c}_{32}^{(3)*}$
					$\mathbf{m}^{(1)} - \mathbf{c}_{32}^{(4)*}$
			$\mathbf{m}^{(2)} - \mathbf{c}_8^{(2)}$	$\mathbf{m}^{(2)} - \mathbf{c}_{16}^{(3)}$	$\mathbf{m}^{(2)} - \mathbf{c}_{32}^{(5)}$
					$\mathbf{m}^{(2)} - \mathbf{c}_{32}^{(6)*}$
				$\mathbf{m}^{(2)} - \mathbf{c}_{16}^{(4)*}$	$\mathbf{m}^{(2)} - \mathbf{c}_{32}^{(7)*}$
					$\mathbf{m}^{(2)} - \mathbf{c}_{32}^{(8)*}$
		$\mathbf{m}^{(3)} - \mathbf{c}_4^{(2)}$	$\mathbf{m}^{(3)} - \mathbf{c}_8^{(3)}$	$\mathbf{m}^{(3)} - \mathbf{c}_{16}^{(5)}$	$\mathbf{m}^{(3)} - \mathbf{c}_{32}^{(9)}$
					$\mathbf{m}^{(3)} - \mathbf{c}_{32}^{(10)*}$
				$\mathbf{m}^{(3)} - \mathbf{c}_{16}^{(6)*}$	$\mathbf{m}^{(3)} - \mathbf{c}_{32}^{(11)*}$
					$\mathbf{m}^{(3)} - \mathbf{c}_{32}^{(12)*}$
			$\mathbf{m}^{(6)} - \mathbf{c}_8^{(4)}$	$\mathbf{m}^{(6)} - \mathbf{c}_{16}^{(7)}$	$\mathbf{m}^{(6)} - \mathbf{c}_{32}^{(13)}$
					$\mathbf{m}^{(6)} - \mathbf{c}_{32}^{(14)*}$
				$\mathbf{m}^{(6)} - \mathbf{c}_{16}^{(8)*}$	$\mathbf{m}^{(6)} - \mathbf{c}_{32}^{(15)*}$
					$\mathbf{m}^{(6)} - \mathbf{c}_{32}^{(16)*}$
	$\mathbf{m}^{(5)} - \mathbf{c}_2^{(2)}$	$\mathbf{m}^{(5)} - \mathbf{c}_4^{(3)}$	$\mathbf{m}^{(5)} - \mathbf{c}_8^{(5)}$	$\mathbf{m}^{(5)} - \mathbf{c}_{16}^{(9)}$	$\mathbf{m}^{(5)} - \mathbf{c}_{32}^{(17)}$
					$\mathbf{m}^{(5)} - \mathbf{c}_{32}^{(18)*}$
				$\mathbf{m}^{(5)} - \mathbf{c}_{16}^{(10)*}$	$\mathbf{m}^{(5)} - \mathbf{c}_{32}^{(19)*}$
					$\mathbf{m}^{(5)} - \mathbf{c}_{32}^{(20)*}$

			$\mathbf{m}^{(4)} - \mathbf{c}_8^{(6)}$	$\mathbf{m}^{(4)} - \mathbf{c}_{16}^{(11)}$	$\mathbf{m}^{(4)} - \mathbf{c}_{32}^{(21)}$
					$\mathbf{m}^{(4)} - \mathbf{c}_{32}^{(22)*}$
				$\mathbf{m}^{(4)} - \mathbf{c}_{16}^{(12)*}$	$\mathbf{m}^{(4)} - \mathbf{c}_{32}^{(23)*}$
					$\mathbf{m}^{(4)} - \mathbf{c}_{32}^{(24)*}$
		$\mathbf{m}^{(7)} - \mathbf{c}_4^{(4)}$	$\mathbf{m}^{(7)} - \mathbf{c}_8^{(7)}$	$\mathbf{m}^{(7)} - \mathbf{c}_{16}^{(13)}$	$\mathbf{m}^{(7)} - \mathbf{c}_{32}^{(25)}$
					$\mathbf{m}^{(7)} - \mathbf{c}_{32}^{(26)*}$
				$\mathbf{m}^{(7)} - \mathbf{c}_{16}^{(14)*}$	$\mathbf{m}^{(7)} - \mathbf{c}_{32}^{(27)*}$
					$\mathbf{m}^{(7)} - \mathbf{c}_{32}^{(28)*}$
			$\mathbf{m}^{(8)} - \mathbf{c}_8^{(8)}$	$\mathbf{m}^{(8)} - \mathbf{c}_{16}^{(15)}$	$\mathbf{m}^{(8)} - \mathbf{c}_{32}^{(29)}$
					$\mathbf{m}^{(8)} - \mathbf{c}_{32}^{(30)*}$
				$\mathbf{m}^{(8)} - \mathbf{c}_{16}^{(16)*}$	$\mathbf{m}^{(8)} - \mathbf{c}_{32}^{(31)*}$
					$\mathbf{m}^{(8)} - \mathbf{c}_{32}^{(32)*}$

Figure 6 - Association of Midambles to Spreading Codes for Burst Type 1-3 and $K_{Cell} = 8$

-- Association for Burst Type 1-3 and $K_{Cell} = 4$ Midambles

$\mathbf{m}^{(1)} - \mathbf{c}_1^{(1)}$	$\mathbf{m}^{(1)} - \mathbf{c}_2^{(1)}$	$\mathbf{m}^{(1)} - \mathbf{c}_4^{(1)}$	$\mathbf{m}^{(1)} - \mathbf{c}_8^{(1)}$	$\mathbf{m}^{(1)} - \mathbf{c}_{16}^{(1)}$	$\mathbf{m}^{(1)} - \mathbf{c}_{32}^{(1)}$
					$\mathbf{m}^{(1)} - \mathbf{c}_{32}^{(2)*}$
				$\mathbf{m}^{(1)} - \mathbf{c}_{16}^{(2)*}$	$\mathbf{m}^{(1)} - \mathbf{c}_{32}^{(3)*}$
					$\mathbf{m}^{(1)} - \mathbf{c}_{32}^{(4)*}$
			$\mathbf{m}^{(1)} - \mathbf{c}_8^{(2)*}$	$\mathbf{m}^{(1)} - \mathbf{c}_{16}^{(3)*}$	$\mathbf{m}^{(1)} - \mathbf{c}_{32}^{(5)*}$
					$\mathbf{m}^{(1)} - \mathbf{c}_{32}^{(6)*}$
				$\mathbf{m}^{(1)} - \mathbf{c}_{16}^{(4)*}$	$\mathbf{m}^{(1)} - \mathbf{c}_{32}^{(7)*}$
					$\mathbf{m}^{(1)} - \mathbf{c}_{32}^{(8)*}$
		$\mathbf{m}^{(3)} - \mathbf{c}_4^{(2)}$	$\mathbf{m}^{(3)} - \mathbf{c}_8^{(3)}$	$\mathbf{m}^{(3)} - \mathbf{c}_{16}^{(5)}$	$\mathbf{m}^{(3)} - \mathbf{c}_{32}^{(9)}$
					$\mathbf{m}^{(3)} - \mathbf{c}_{32}^{(10)*}$
				$\mathbf{m}^{(3)} - \mathbf{c}_{16}^{(6)*}$	$\mathbf{m}^{(3)} - \mathbf{c}_{32}^{(11)*}$
					$\mathbf{m}^{(3)} - \mathbf{c}_{32}^{(12)*}$
			$\mathbf{m}^{(3)} - \mathbf{c}_8^{(4)*}$	$\mathbf{m}^{(3)} - \mathbf{c}_{16}^{(7)*}$	$\mathbf{m}^{(3)} - \mathbf{c}_{32}^{(13)*}$
					$\mathbf{m}^{(3)} - \mathbf{c}_{32}^{(14)*}$
				$\mathbf{m}^{(3)} - \mathbf{c}_{16}^{(8)*}$	$\mathbf{m}^{(3)} - \mathbf{c}_{32}^{(15)*}$
					$\mathbf{m}^{(3)} - \mathbf{c}_{32}^{(16)*}$
	$\mathbf{m}^{(5)} - \mathbf{c}_2^{(2)}$	$\mathbf{m}^{(5)} - \mathbf{c}_4^{(3)}$	$\mathbf{m}^{(5)} - \mathbf{c}_8^{(5)}$	$\mathbf{m}^{(5)} - \mathbf{c}_{16}^{(9)}$	$\mathbf{m}^{(5)} - \mathbf{c}_{32}^{(17)}$
					$\mathbf{m}^{(5)} - \mathbf{c}_{32}^{(18)*}$
				$\mathbf{m}^{(5)} - \mathbf{c}_{16}^{(10)*}$	$\mathbf{m}^{(5)} - \mathbf{c}_{32}^{(19)*}$
					$\mathbf{m}^{(5)} - \mathbf{c}_{32}^{(20)*}$
			$\mathbf{m}^{(5)} - \mathbf{c}_8^{(6)*}$	$\mathbf{m}^{(5)} - \mathbf{c}_{16}^{(11)*}$	$\mathbf{m}^{(5)} - \mathbf{c}_{32}^{(21)*}$
					$\mathbf{m}^{(5)} - \mathbf{c}_{32}^{(22)*}$
				$\mathbf{m}^{(5)} - \mathbf{c}_{16}^{(12)*}$	$\mathbf{m}^{(5)} - \mathbf{c}_{32}^{(23)*}$
					$\mathbf{m}^{(5)} - \mathbf{c}_{32}^{(24)*}$
		$\mathbf{m}^{(7)} - \mathbf{c}_4^{(4)}$	$\mathbf{m}^{(7)} - \mathbf{c}_8^{(7)}$	$\mathbf{m}^{(7)} - \mathbf{c}_{16}^{(13)}$	$\mathbf{m}^{(7)} - \mathbf{c}_{32}^{(25)}$
					$\mathbf{m}^{(7)} - \mathbf{c}_{32}^{(26)*}$
				$\mathbf{m}^{(7)} - \mathbf{c}_{16}^{(14)*}$	$\mathbf{m}^{(7)} - \mathbf{c}_{32}^{(27)*}$
					$\mathbf{m}^{(7)} - \mathbf{c}_{32}^{(28)*}$
			$\mathbf{m}^{(7)} - \mathbf{c}_8^{(8)*}$	$\mathbf{m}^{(7)} - \mathbf{c}_{16}^{(15)*}$	$\mathbf{m}^{(7)} - \mathbf{c}_{32}^{(29)*}$
					$\mathbf{m}^{(7)} - \mathbf{c}_{32}^{(30)*}$
				$\mathbf{m}^{(7)} - \mathbf{c}_{16}^{(16)*}$	$\mathbf{m}^{(7)} - \mathbf{c}_{32}^{(31)*}$
					$\mathbf{m}^{(7)} - \mathbf{c}_{32}^{(32)*}$

Figure 7 - Association of Midambles to Spreading Codes for Burst Type 1-3 and $K_{Cell} = 4$

Mapping of transport channels to physical channels

The mapping of transport channels to physical channels is identical to that of 3.84Mcps TDD of section 7 of [5] with the exception that a maximum of (M=8) HS-SCCH may be associated with an HS-DSCH for one UE.

4.3.2 Multiplexing and channel coding

The higher chip rate reference configuration shall apply the 3.84Mcps TDD method of multiplexing and channel coding as defined in 25.222 [3] with the following exceptions :

The channelisation code-set information field of the HS-SCCH shall be 10 bits ($x_{ccs,1},\ldots x_{ccs,10}$) (cf section 4.6 of 25.222 [3]). $x_{ccs,1},\ldots x_{ccs,5}$ define the start code of the allocation, $x_{ccs,6},\ldots x_{ccs,10}$ define the stop code of the allocation. If the signaled start code of the allocation is 32 and the signaled stop code is 1, a spreading factor SF=1 shall be used for the HS-PDSCH resources.

Note that the transport block size information for HS-SCCH for the higher chip rate reference configuration shall be coded on 9 bits as per 3.84Mcps TDD. It may be assumed that a mapping of transport block size information to actual transport block size is available that does not significantly impact performance.

4.3.3 Spreading and modulation

The higher chip rate reference configuration shall apply the 3.84Mcps TDD method of spreading and modulation as defined in TS 25.223 [4] with the following exceptions:

General

The basic modulation parameters of the 7.68 Mcps UTRA TDD reference system are given in Table 2 :

Table 2 - Basic modulation parameters of reference configuration

Chip rate	7.68 Mcps
Data modulation	QPSK / 16 QAM (HS-PDSCH only)
Spreading characteristics	Orthogonal Q chips / symbol, Where $Q = 2^p$, $0 <= p <= 5$

Data Modulation

The data modulation is identical to that of 3.84 Mcps UTRA TDD mode (cf section 5 of 25.223 [4]). The number of symbols per data field is adapted to the burst formats defined in section 4.3.1.

Spreading Modulation

The spreading modulation is identical to that of 3.84 Mcps UTRA TDD mode (cf section 7 of 25.223 [4]) with the exception that the real valued channelisation codes are of length Q_k ? {1,2,4,8,16,32}. The channelisation codes are Orthogonal Variable Spreading Factor (OVSF) codes and are generated as described for 3.84 Mcps UTRA TDD mode.

Associated with each channelisation code is a multiplier taking values from the set { $e^{j? / 2?p_k}$ }, where p_k is a permutation of the integer set {0,…,Q_k-1} and Q_k is the spreading factor. The values of the multiplier for Q_k = {1,2,4,8,16} are identical to those of 3.84 Mcps UTRA TDD mode. For Q_k = 32 the multiplier values are given in Table 3:

Table 3 - multiplier values for Q_k = 32

K	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
$W_{Q?32}^{(k)}$	-i	-1	-1	1	-1	-i	i	1	-1	1	1	-i	i	-1	i	-i

K	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32

$W_{Q?32}^{(k)}$	-i	-i	1	i	-1	-i	-i	-i	-1	-1	i	-1	-i	1	-1	-1

The scrambling codes for the 7.68 Mcps UTRA TDD reference system shall be of length 32 chips and are formed by concatenation of the existing length 16 chip scrambling codes described in Annex A of TS 25.223 [4]. The concatenation of existing scrambling codes *m* and *n* is shown in Figure 8 where *m, n* ? {0,…,127} and *m* ? *n*:

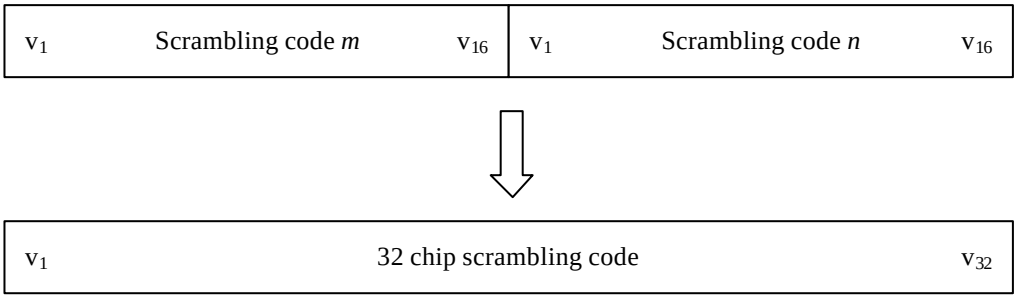

Figure 8: Concatenation of length 16 chip scrambling codes.

The mapping scheme for Cell Parameters and constituent scrambling codes for the 7.68 Mcps UTRA TDD reference system is shown in Table 4. The cycling of cell parameters with system frame numbering is identical to that of the 3.84 Mcps UTRA TDD mode as described in Section 8.3 (Table 7) of TS 25.233 [4].

Table 4: Mapping scheme for Cell Parameters and TS 25.223 constituent scrambling codes.

Cell Parameter	TS 25.223 scrambling code *m*	TS 25.223 scrambling code *n*
0	0	2
1	1	3
2	2	4
3	3	5
	. . . .	
124	124	126
125	125	127
126	126	0
127	127	1

When different physical channels are combined in the uplink the weight factors $?_i$ of Table 5 are applied depending on the spreading factor SF of the corresponding DPCH.

Table 5 - weight factors for reference configuration

SF of $DPCH_i$	$?_i$
32	$\sqrt{2}/8$
16	$1/4$
8	$\sqrt{2}/4$

4	$1/2$
2	$\sqrt{2}/2$
1	1

Synchronisation codes

Code Generation

The synchronisation codes shall be constructed in the same manner as defined in sub-clause 8.1 of [4]. For the 7.68Mcps reference configuration repetition encoding shall be applied to both the primary and secondary synchronization codes. In this instance each element of the code is repeated twice.

Using the notation of sub-clause 8.1 of [4], the primary synchronization code is defined as

$$C_p = \langle y(0), y(0), y(1), y(1), \ldots, y(255), y(255) \rangle$$

Similarly, the i[th] secondary SCH code word, $C_{,i}$, i = 0, 1, 3, 4, 5, 6, 8, 10, 12, 13, 14, 15 is defined as

$$C_i = (1 - j) \langle h_m(0) z(0), h_m(0) z(0), h_m(1) z(1), h_m(1) z(1), \ldots, h_m(255) z(255), h_m(255) z(255) \rangle$$

where $m = (16 i)$ and the leftmost chip in the sequence corresponds to the chip transmitted first in time. The length of the synchronization codes in the SCH is 512.

Code Allocation

Code allocation is identical to sub-clause 8.2 of [4] with the following exceptions to 8.2.1 and 8.2.2:

Code Allocation for Case 1

There are 32 code groups 0,1,..,31, define $u = (u_0, u_1, u_2, u_3, u_4)$ as the binary representation of the code group number. The radio frame is denoted by

$$f = \begin{cases} 0 & \text{Frame 1} \\ 1 & \text{Frame 2} \end{cases}$$

and denote C_r as a Boolean variable, where

$$C_r = \begin{cases} 0 & \text{3.84Mcps} \\ 1 & \text{7.68Mcps} \end{cases}$$

Define the following generator matrix

$$G^{(1)} = \begin{bmatrix} 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 \\ 1 & 0 & 1 & 0 & 0 & 0 \end{bmatrix}$$

with rows $g_0^{(1)}, g_1^{(1)}, g_2^{(1)}, g_3^{(1)}, g_4^{(1)}$, and the binary codeword a as

$$a = (d G^{(1)} z) \bmod 2$$

where $a = (a_0, \ldots, a_5)$, $d = (C_r, f, u_0, u_1, u_2)$ and $z = u_3 u_2 1 \bmod 2 = g_4^{(1)}$. Map the elements of the codeword a pairwise to the set of integers $(0,1,2,3)$ using the expression

$$s_k = 2a_{2k+1} + a_{2k} \quad ; \quad k = 0,1,2$$

The sequence $s = (s_0, s_1, s_2)$ has an associated complex sequence $b = (j^{s_0}, j^{s_1}, j^{s_2})$. The code construction is defined by the component wise product:

$$C_s = bC$$

The code set permutation is given in Table 6 below. When $C_r = 0$, the codeword produced by the generator matrix matches the sequences defined in sub-clause 8.2.1 of [4].

Table 6- code set permutations for case 1

(u_4, u_3, u_2)	Code Group	Code Set Permutation, C
000	0–3	$c_1 c_3 c_5$
001	4–7	$c_1 c_3 c_5$
010	8–11	$c_1 c_5 c_3$
011	12–15	$c_3 c_5 c_1$
100	16–19	$c_{10} c_{13} c_{14}$
101	20–23	$c_{10} c_{13} c_{14}$
110	24–27	$c_{10} c_{14} c_{13}$
111	28–31	$c_{13} c_{14} c_{10}$

Code Allocation for Case 2

There are 32 code groups 0,1,..,31, define $u = (u_0, u_1, u_2, u_3, u_4)$ as the binary representation of the code group number, where u_0 is the LSB. The radio frame is denoted by

$$f = \begin{cases} 0 & \text{Frame 1} \\ 1 & \text{Frame 2} \end{cases}$$

Denote C_r as a Boolean variable, where

$$C_r = \begin{cases} 0 & 3.84\text{Mcps} \\ 1 & 7.68\text{Mcps} \end{cases}$$

and

$$TS = \begin{cases} 0 & \text{slot } k \\ 1 & \text{slot } k+8 \end{cases}$$

Define the following generator matrix

$$G^{(2)} = \begin{bmatrix} 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 \\ 0 & 1 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 \\ 1 & 0 & 1 & 0 & 0 & 0 \end{bmatrix}$$

with rows labelled $g_0^{(2)}, g_1^{(2)}, g_2^{(2)}, g_3^{(2)}, g_4^{(2)}$ and the binary codeword a as

$$a = dG^{(2)} = z \bmod 2$$

where $a = (a_0, \ldots, a_5)$, $d = (C_r, TS, f, u_0, u_1)$, and $z = u_2 (u_1 + 1) \bmod 2 + g_4^{(2)}$. Map the elements of the codeword a pairwise to the set of integers $(0,1,2,3)$ using the expression

$$s_k = 2a_{2k+1} + a_{2k} \quad ; \quad k = 0,1,2$$

The sequence $s = (s_0, s_1, s_2)$ has an associated complex sequence $b = (j^{s_0}, j^{s_1}, j^{s_2})$. The code construction is defined by the component wise product:

$$C_s = bC$$

The code set permutation is defined in Table 7 below. When $C_r = 0$ the codeword produced by the generator matrix matches the sequences defined in sub-clause 8.2.2 of [4].

Table 7 - code set permutations for case 2

(u_4, u_3, u_2, u_1)	Code Group	Code Set Permutation, C
0000	0 – 1	$c_1 c_3 c_5$
0001	2 – 3	$c_1 c_3 c_5$
0010	4 – 5	$c_1 c_5 c_3$
0011	6 – 7	$c_3 c_5 c_1$
0100	8 – 9	$c_{10} c_{13} c_{14}$
0101	10 – 11	$c_{10} c_{13} c_{14}$
0110	12 – 13	$c_{10} c_{14} c_{13}$
0111	14 – 15	$c_{13} c_{14} c_{10}$
1000	16 – 17	$c_0 c_6 c_{12}$
1001	18 – 19	$c_0 c_6 c_{12}$
1010	20 – 21	$c_0 c_{12} c_6$
1011	22 – 23	$c_6 c_{12} c_0$
1100	24 – 25	$c_4 c_8 c_{15}$
1101	26 – 27	$c_4 c_8 c_{15}$
1110	28 – 29	$c_4 c_{15} c_8$
1111	30 – 31	$c_8 c_{15} c_4$

4.3.4 Physical Layer Procedures

The higher chip rate reference configuration shall apply the 3.84Mcps TDD physical layer procedures as defined in 25.224 [6] with the following exceptions:

Timing Advance

The required timing advance shall be represented as a 6-bit number (0-63) 'UL Timing Advance' TA_{ul} , being the multiplier of $4 \times (C_r + 1)$ chips which is nearest to the required timing advance, where

$$C_r = \begin{cases} 0 & 3.84\text{Mcps} \\ 1 & 7.68\text{Mcps} \end{cases}$$

On receipt of TA_{ul} the UE shall adjust the timing of its transmissions accordingly in steps of $4 \times (C_r + 1)$ chips.

Cell Search Procedure

A higher chip rate enabled UE can be reconfigured to operate at 3.84Mcps and 7.68Mcps.

Step 2: Cell Chip Rate, Code Group Identification and Slot synchronization

During the second step of the cell search procedure, the UE shall use the SCH's secondary synchronization codes to simultaneously identify both cell chip rate and 1 out of 32 code groups for the cell found in the first step. Since this information is solely contained in the modulation sequence, the same method of sequence identification employed at

3.84Mcps can be reused at 7.68Mcps. Before proceeding to the third step of the cell search procedure, there shall be a reconfiguration of the UE transmitter and receiver to reflect the signaled cell chip rate.

4.3.5 Physical Layer Measurements

The physical layer measurements defined for the reference configuration are identical to those defined in [7] for 3.84Mcps TDD with the following exceptions :

SFN-SFN Observed time difference

The SFN-SFN observed time difference is defined identically to [7] where for 7.68Mcps :

SFN-SFN observed time difference = $OFF \cdot 76800 \cdot T_m$ *in chips for* 7.68*Mcps TDD* where:

T_m is in the range $\{0,1,...,76799$ *chips for* 7.68 *Mcps TDD*$\}$

SFN-CFN observed time difference

T_m is in the range $\{0,1,...,76799$ *chips for* 7.68 *Mcps TDD*$\}$

4.3.6 UE Capabilities

The reference configuration shall assume that UEs are not restricted in terms of their UE capabilities. The reference configuration shall assume that a form of multi-user detector used at 3.84Mcps is modified to operate at the higher chip rate.

4.4 Protocol aspects

The reference configuration assumes that there are no protocol changes from 3.84Mcps TDD. It is assumed that higher layer signalling is extended to cover the higher chip rate.

5 Analysis

[Editor's note : This section will provide results on the performance and complexity of the reference higher chip rate configuration described in section 4].

5.1 Reference Channel Models

[Editor's note : simulations in clause 5 are based on the reference channel models in this subclause. The channel models in this subclause allow for a fair evaluation of higher chip rate UTRA TDD relative to current releases]

5.2 Link Level Results

5.2.1 Release 99/4 type bearers

[Editor's note : to be included].

5.2.2 Release 5 type (HSDPA) bearers

[Editor's note : link level results for some 7.68Mcps HSDPA reference channels in 2 channel types are included. Other channel types and results for 3.84Mcps are required].

Link level results for 7.68Mcps release 5 type HSDPA bearers are provided in the figures of this subclause according to table 8. Note that the "ID" in these figures refers to the fixed reference channel ID of Table A.1.

Table 8 - List of Link Level Results Figures

figure	channel	mean / instantaneous	chip rate
9	AWGN	mean	7.68
10	PA3	mean	7.68
11	PA3	instantaneous	7.68
[etc.]	[etc.]	[etc.]	[etc.]

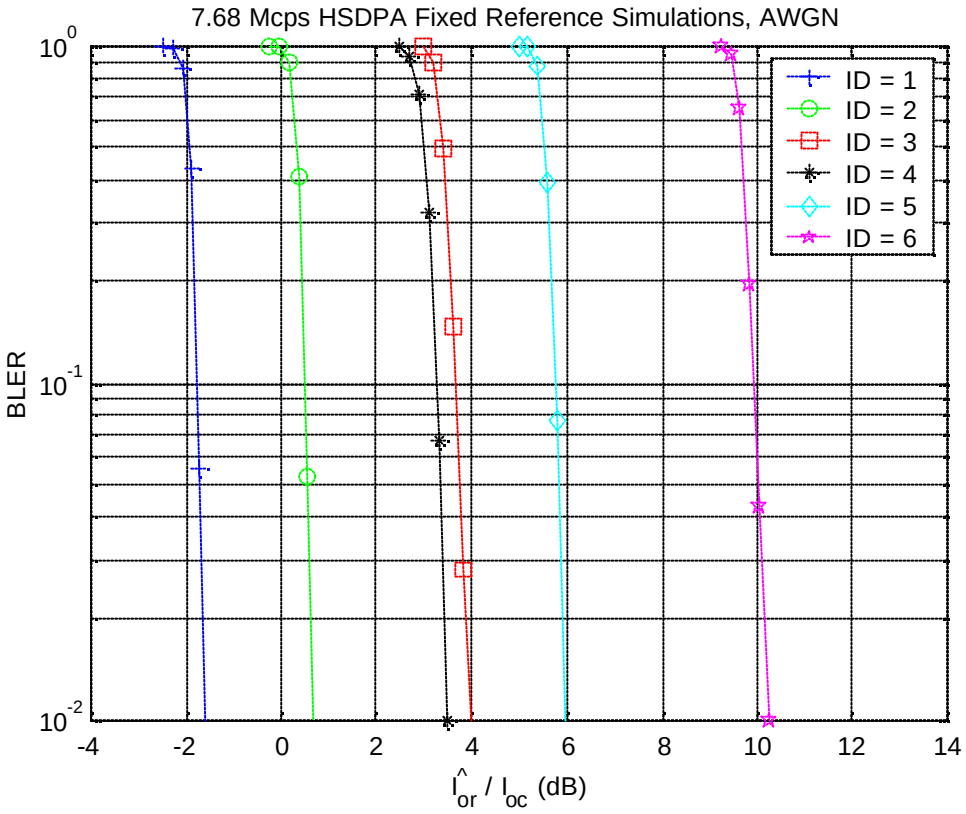

Figure 9 - Link level results for 7.68Mcps HSDPA fixed reference channel simulations in AWGN (mean $\hat{I}_{or}/I_{oc}$)

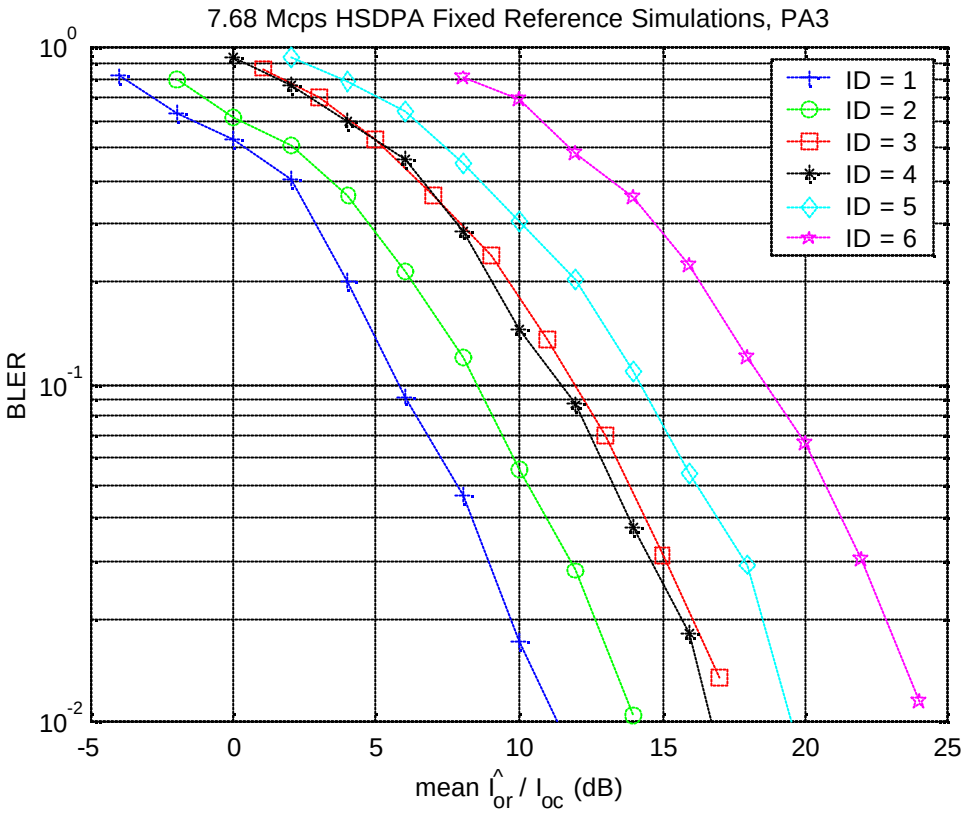

Figure 10 – Link level results for 7.68Mcps HSDPA fixed reference channel simulations in channel PA3 (mean $\hat{I}_{or}/I_{oc}$)

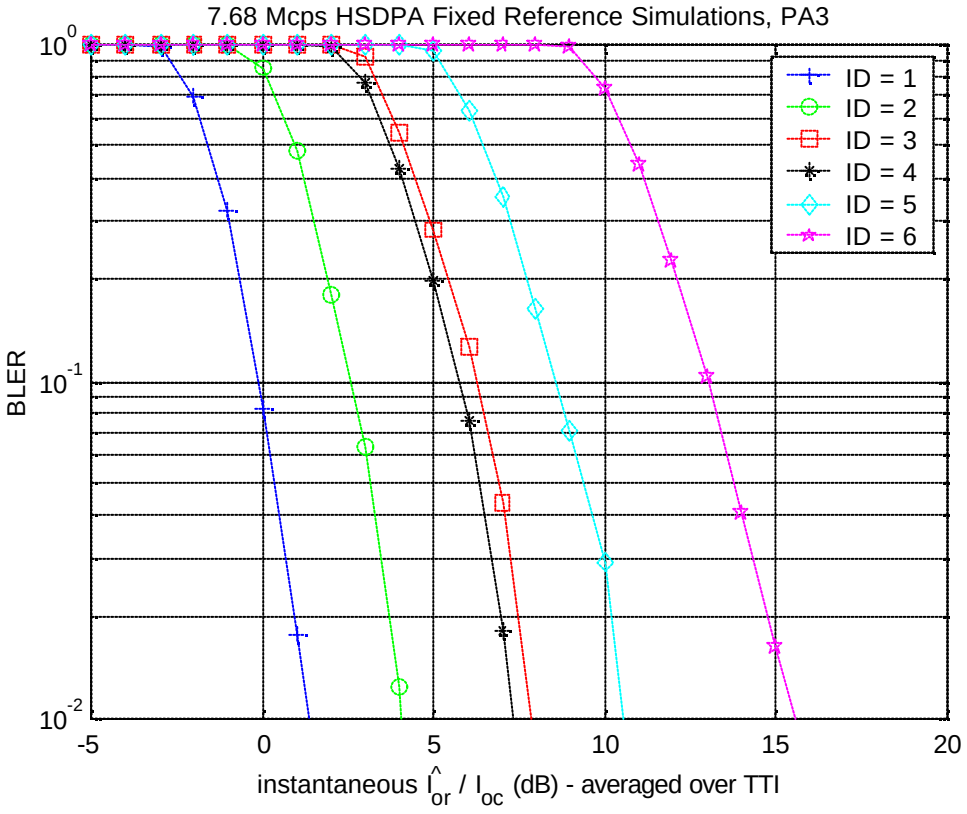

Figure 11 – Link level results for 7.68Mcps HSDPA fixed reference channel simulations in channel PA3 (instantaneous $\hat{I}_{or}/I_{oc}$ averaged over a TTI)

5.3 System Level Results

[Editor's note : This section provides results on cell throughput, outage, number of users supported for varying radio bearer configurations etc.]

5.4 Link Budget

[Editor's note : This section examines the link budget of the reference configuration. Coverage can be derived from the link budget performance].

5.5 Complexity Analysis

[Editor's note : the complexity analyses in sections 5.5.1, 5.5.2 and 5.5.3 shall account for the complexity impact of a higher chip rate UTRA TDD being required to decode up to M=8 HS-SCCH compared to the M=4 HS-SCCH that must be decoded by a 3.84Mcps TDD UE].

5.5.1 UE Complexity

[Editor's note : Analysis of higher chip rate UTRA TDD UE complexity, comparison relative to 3.84Mcps TDD Release 5].

5.5.2 UTRAN Complexity

[Editor's note : Analysis of higher chip rate UTRA TDD UTRAN complexity, comparison relative to 3.84Mcps TDD Release 5 : Node B and RNC].

5.5.3 Dual mode 3.84Mcps / 7.68Mcps UEs

[Editor's note : Analysis of feasibility from a complexity and performance perspective of dual mode TDD UEs in order to allow for roaming and backwards compatibility (a dual mode TDD UE is understood in this context to implement both 3.84Mcps TDD and 7.68Mcps TDD)].

6 Feasibility

6.1 Coexistence with existing UTRA releases

[Editor's note : Discusses aspects of the coexistence of high chip rate UTRA TDD with 3.84Mcps TDD and FDD that are within the scope of 3GPP. Coexistence will be considered in diverse spectrum arrangements and allocations such as future spectrum allocations. Aspects of coexistence between higher chip rate TDD and FDD will be compared to Release 99 coexistence].

6.2 Use in diverse spectrum arrangements and allocations

[Editor's note : Discusses in which spectrum arrangements and allocations UTRA TDD may be feasible].

6.3 Mobility

[Editor's note : feasibility of mobility between higher chip rate UTRA TDD, 3.84Mcps TDD, FDD and GSM. Mobility in RRC connected mode states and idle mode shall be considered. Mobility aspects to and from higher chip rate UTRA TDD shall be considered: for example in the case of handover, feasibility of handover from higher chip rate UTRA TDD to higher chip rate UTRA TDD, 3.84Mcps TDD, FDD and GSM as well as feasibility of handover to higher chip rate UTRA TDD from higher chip rate UTRA TDD, 3.84Mcps TDD, FDD and GSM are considered].

6.4 Application to 3GPP system and services

[Editor's note : feasibility of supporting personal, multimedia, broadcast etc. services on higher chip rate UTRA TDD].

6.5 Backward Compatibility

6.5.1 Operation of higher chip rate UEs in 3.84Mcps TDD infrastructure

It is clear that a UE that can only operate at the higher chip rate will not get service from a 3.84Mcps UTRAN. This situation is analogous to the case where DCS1800 only UEs do not get service from a GSM900 network.

Due to the similarity in the coding of the SCH, a dual mode (higher chip rate / 3.84Mcps TDD) UE is able to identify the chip rate and code group for a cell no matter whether the cell operates at 3.84Mcps or the higher chip rate. If, from the modulation of the SCH, the dual mode UE identifies that the cell operates at 3.84Mcps, it can reconfigure itself to operate at 3.84Mcps.

6.5.2 Operation in multiple frequency bands

In the case that higher chip rate TDD is implemented solely in one frequency band and 3.84Mcps TDD is implemented solely in another frequency band, there are no backwards compatibility issues : 3.84Mcps UEs are serviced in one band, higher chip rate UEs in the other band, dual mode UEs may be serviced in either band.

6.5.3 Operation of 3.84Mcps TDD UEs when higher chip rate UTRAN is deployed

When 3.84Mcps TDD carriers and higher chip rate TDD carriers are both deployed in the same band, 3.84Mcps UEs will not attempt to camp on to higher chip rate carriers since they :

1) are unlikely to correctly decode the code group for the higher chip rate cell

2) will be unable to correctly read system information and will thus reject the higher chip rate cell

These 3.84Mcps TDD UEs will then be able to camp on 3.84Mcps carriers in the same band.

6.5.4 Servicing of 3.84Mcps TDD UEs under higher chip rate UTRAN

Both 3.84Mcps TDD UEs and higher chip rate UEs can be serviced by a higher chip rate UTRAN when the higher chip rate UTRAN is dual mode. An example timeslot arrangement for dual mode higher chip rate UTRAN is given in Figure 12. In this arrangement, two separate chip rates can be accommodated in the same frame; the two chip rates may operate independently of one another. Each chip rate carries its own SCH and beacon function. 3.84Mcps TDD UEs will camp on the cell according to the 3.84Mcps TDD SCH and beacon. Higher chip rate UEs will camp on to the cell according to the higher chip rate TDD SCH and beacon. Dual mode UEs may be "handed over" between the timeslots within the frame. Additional higher layer modifications would be needed to support this configuration.

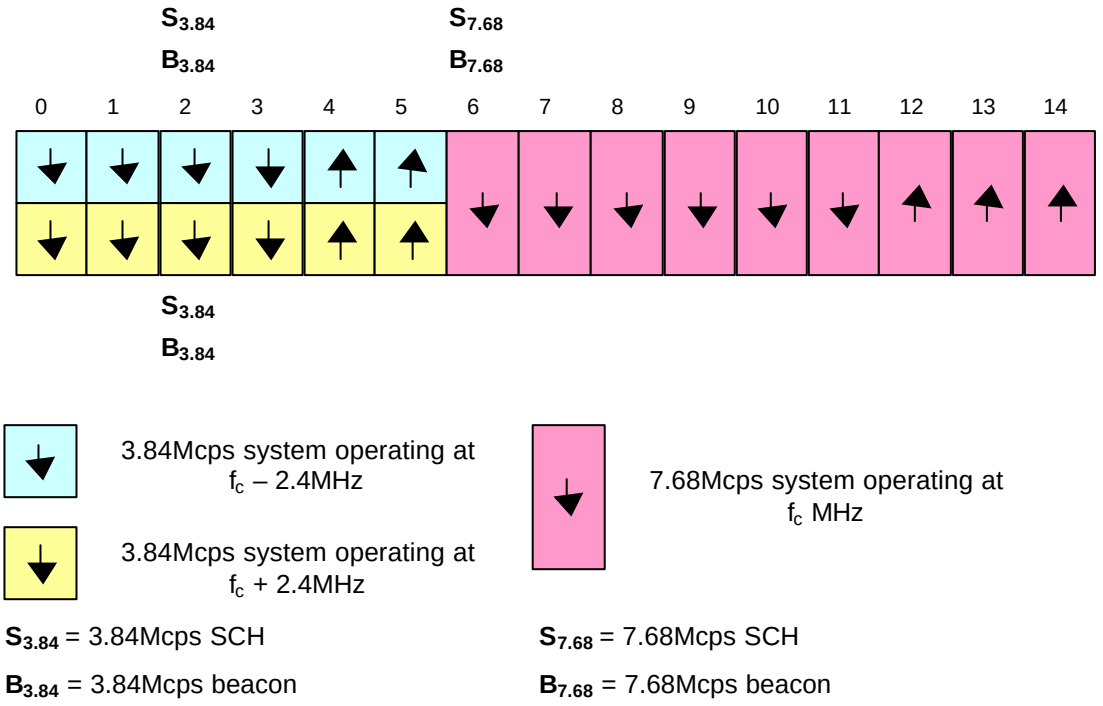

Figure 12 – frame structure allowing 3.84Mcps TDD and higher chip rate UEs to be serviced by a dual mode higher chip rate UTRAN

6.5.4 Operation of higher chip rate as an auxiliary downlink

Both 3.84Mcps TDD UEs and higher chip rate TDD UEs may be serviced when the higher chip rate TDD is used as an auxiliary downlink carrier. This operation is shown in Figure 13. 3.84Mcps TDD UEs are serviced by the 3.84Mcps carrier. Higher chip rate UEs can be serviced by the 3.84Mcps carrier (e.g. for uplink) and by the 7.68Mcps carrier (e.g. for downlink). The higher chip rate UE operates in a half-duplex mode.

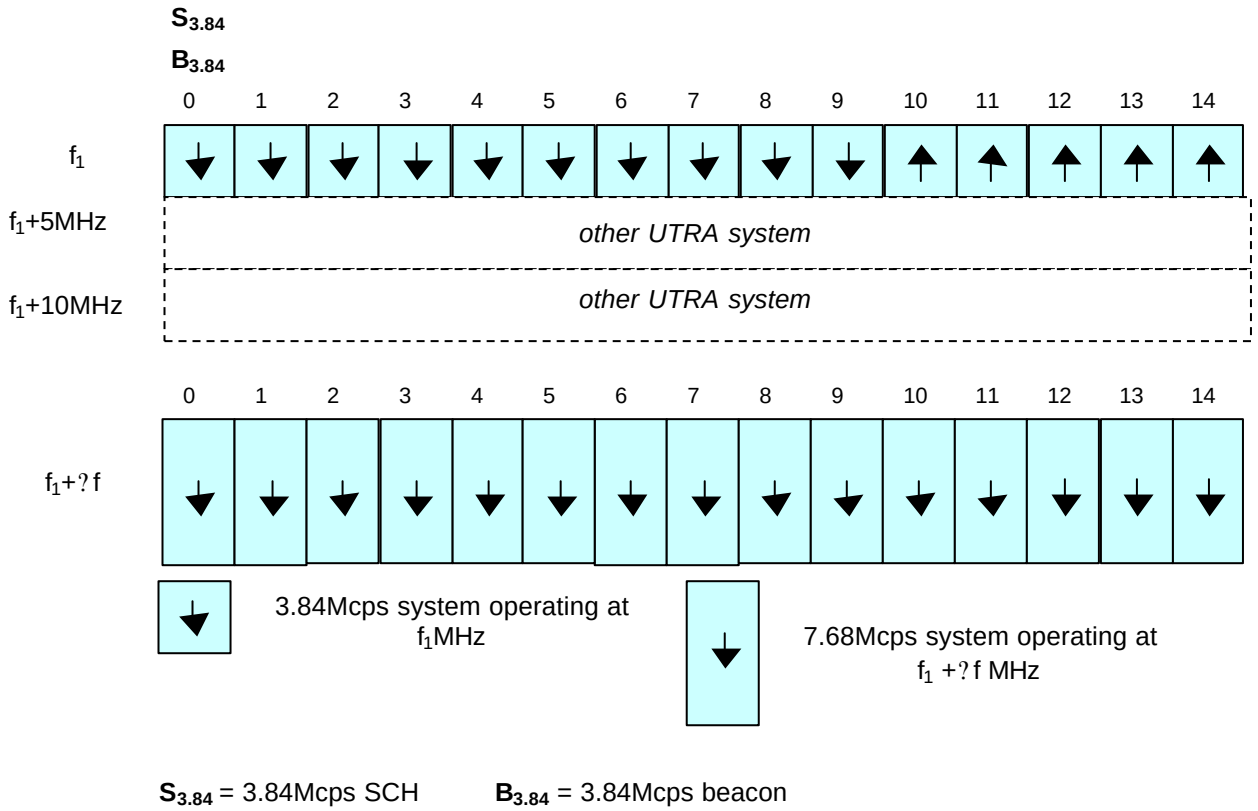

Figure 13 - Example operation of higher chip rate TDD as an auxiliary downlink

6.6 Impact on other working groups

[Editor's note : Impact on RAN2, RAN3 and RAN4. Impacts may include signalling, RLC parameters, tests, channel models etc.]

6.7 Impact on Specifications

[Editor's note : discusses feasibility of incorporating higher chip rate UTRA TDD in 3GPP specifications at a technical level].

6.8 Signalling Impact

[Editor's note : discusses signalling required to support higher chip rate UTRA TDD].

6.9 Antenna Systems

[Editor's note : discussion of feasibility of transmit diversity schemes and "multiple input multiple output" (MIMO) systems].

6.10 Higher chip rates than 7.68Mcps

[Editor's note : discussion of feasibility of chip rates higher than 7.68Mcps based on the studied reference 7.68Mcps system].

7 Recommendations and Conclusions

[Editor's note : Conclusions on the feasibility and potential benefits of introducing higher chip rate UTRA TDD in UTRAN and, if appropriate, a recommendation to RAN Plenary on a potential work item time-frame and work plan].

Annex A (normative): Link Level Simulation Assumptions

A.1 Description of Bearer Services

Both circuit-switched speech/data and HSDPA-like packet-switched bearer services shall be evaluated.

A.1.1 Release 99/4 Type

A.1.1.1 Speech, 12.2 kbps

The normative reference measurement channels of 25.102 [8] annex A2.2 (DL) and 25.105 [9] annex A2.1 (UL) shall be used for simulation purposes. The spreading factors for both uplink and downlink are double those used for the 3.84Mcps system. Note that burst type 1 is used for both link directions for this service.

A.1.1.2 Circuit Switched Data, 384 kbps

The normative reference measurement channels of 25.102 [8] annex A2.5 (DL) and 25.105 [9] annex A2.4 (UL) shall be used for simulation purposes. The spreading factors for both uplink and downlink are double those used for the 3.84Mcps system. Note that burst type 2 is used for both link directions for this service.

A.1.2 Release 5 Type (HSDPA)

A set of fixed-rate reference channels are simulated for HSDPA. These results are generated in order to enable mapping of a short-term channel quality metric to a probability of HS-DSCH transport block failure within a dynamic system-level simulation.

Interpolation between these fixed-rate reference channels is used to infer the performances of other transport block sizes and resource allocations within the dynamic system model.

The six fixed-rate reference channels of Table A.1 are defined for HSDPA simulation.

The physical resource allocation is the same for all of the six channels and is equal to 8 timeslots per 10ms TTI, each containing 4 codes at SF 32.

The redundancy and constellation version, $X_{rv}=\{0,0,0,0\}$ is used for all reference channels.

Table A.1 – Fixed-Rate Reference Channels for HSDPA Link Simulation

Fixed Reference Channel ID	Modulation Type	Burst Type	Available bits across allocated physical channels	Transport Block Size	Approximate Code Rate
1	QPSK	2	8832	2912 bits	1/3
2	QPSK	2	8832	4384 bits	½
3	QPSK	2	8832	6592 bits	¾
4	16 QAM	2	17664	5856 bits	1/3

5	16 QAM	2	17664	8800 bits	½
6	16 QAM	2	17664	13184 bits	¾

A.2 Applicable Propagation Channels

Results shall be obtained in the following propagation channel types for all bearer services:-

?? AWGN

?? ITU Indoor to Outdoor Pedestrian A, 3kmph

?? ITU Indoor to Outdoor Pedestrian B, 3kmph

?? ITU Vehicular A, 30kmph

?? ITU Vehicular A, 120kmph

[Editor's note : The applicability of ITU Vehicular B to CS services is FFS]

A.3 Deployment Specifics

The following deployment-specific parameters are assumed (Table A.2) :-

Table A.2 – Deployment Specific Parameters for Link Simulation

Parameter	Value	Comments
Carrier Frequency	2000 MHz	
Chip Rate	7.68 Mcps	
Tx Antenna Diversity at Node-B	OFF	
Tx Antenna Diversity at UE	OFF	
Rx Antenna Diversity at Node-B	ON	2 antennas
Rx Antenna Diversity at UE	OFF	
Midamble Allocation Scheme, DL	Common Midamble	
Midamble Allocation Scheme, UL	UE-specific	
Cell ID	0	Alternating scrambling code 0/1
Kcell, burst type 1	8	
Kcell, burst type 2	8	For the 7.68Mcps system burst type 2 uses a 512 chip midamble constructed using a 456-long base sequence. Kcell = 4 and 8 are applicable.

A.4 Transmitter Assumptions

Transport channel processing for all bearer services shall comply with 25.222 [3].

The transmit filter shall consist only of an RRC filter with two-sided bandwidth 7.68MHz and roll-off factor ? =0.22.

A.5 Propagation Channel Simulation Assumptions

The channel is simulated at 2 times oversampling with respect to the chip rate.

Channel tap delay positions are quantised to the nearest integer ½ chip position.

A randomly selected delay of 0 or 1 "½ -chips" (both being equi-probable) shall be added to the entire channel impulse response in order to include the effects of sub-chip receiver timing offset.

Doppler shall conform to Jakes spectrum.

A.6 Assumptions on Interference

A.6.1 Intra-cell

A.6.1.1 Downlink

It is assumed for circuit switched services that a total of 16 codes at SF 32 are transmitted each DL timeslot from the Node-B. This number comprises all codes allocated to the user of interest and all intra-cell interferers. This is in line with the highest interference level test scenarios of 25.102 [8] for demodulation of DCH for the equivalent 3.84Mcps system.

For HSDPA services, a higher code space loading is assumed with 24 codes at SF32 being transmitted from the Node-B.

The mean power of all transmitted SF32 codes is assumed to be the same. This leads to the following (Table A.3):-

Table A.3 – Interference Characteristics for Downlink Simulation

Simulated Bearer	**Number of SF32 Codes Occupied by Bearer per Timeslot**	**Number of Interfering Codes at SF32 per Timeslot**	**DPCH or HS-PDSCH $\frac{E_c}{I_{or}}$**	$\frac{DPCH_0\_E_c}{I_{or}}$	$\frac{?\ DPCH_0\_E_c}{I_{or}}$
12.2 kbps Speech	2	14	-12.04 dB	-12.04 dB	-0.58 dB
384 kbps Data	8	8	-12.04 dB	-12.04 dB	-3.01 dB
HSDPA Reference Channels	4	20	-13.8 dB	-13.8 dB	-0.79 dB

A.6.1.2 Uplink

The following scenarios (Table A.4) are considered for the uplink simulations. As for the downlink these are in line with the highest interference level test scenarios of 25.105 [9] for demodulation of DCH for the equivalent 3.84Mcps system. One half of the code space is occupied in total, comprising the user of interest and all intra-cell interferers.

Table A.4 – Interference Characteristics for Uplink Simulation

Bearer	**Resource Occupied by Bearer**	**Number and SF of Interfering Codes per Slot**	**DPCH $\frac{E_c}{I_{or}}$**	$\frac{DPCH_0\_E_c}{I_{or}}$	$\frac{?\ DPCH_0\_E_c}{I_{or}}$
12.2 kbps Speech	1xSF16, 1 TS	14xSF32	-9.03 dB	-12.04 dB	-0.58 dB
384 kbps Data	1xSF4, 3 TS's	8xSF32	-3.01 dB	-12.04 dB	-3.01 dB

A.6.2 Inter-cell

All inter-cell interference (I_{oc}) is assumed to be AWGN-like in nature for both uplink and downlink.

A.7 Receiver Assumptions

The following parameters (Table A.5) of relevance to the receiver shall be used:-

Table A.5 – Receiver Parameters for Link Simulation

Parameter	Value	Comments
Receiver channelisation filter	RRC	Identical to Tx pulse shaping filter
Channel estimation	Realistic, based on midamble	Joint channel estimation using cyclic correlation
Detection	Advanced receiver (eg: MMSE Multi-User Detection)	Only intra-cell signals are jointly detected
Soft Metric for Channel Decoding	LLR	Log Likelihood Ratio
LLR Generation	Ideal	The exact theoretical LLR mapping given an SNR estimate
SNR estimation for LLR generation	Realistic	Based either on midamble or data
Turbo Decoding	Max Log MAP, 4 iterations	

A.8 Power Control

A.8.1 Downlink

For 12.2kbps speech and 384kbps circuit-switched data bearer services, closed inner-loop TPC-based power control is enabled. Outer-loop (quality-based) power control is disabled.

For the 12.2kbps speech and 384kbps data services TPC detection errors are generated randomly with probability n% where "n" is derived from the TPC reliability results of the corresponding uplink simulations at the same data rate and separately for each propagation channel type. For both 12.2kbps and 384kbps circuit switched services, n is the probability of TPC error at 1% UL DCH BLER.

TPC is neither simulated nor employed for HSDPA services. All HS-PDSCH are transmitted with the same power.

A.8.2 Uplink

All uplink channels utilise open-loop inner-loop power control as described within 25.331 [10] section 8.5.7. The delay between the most recent beacon measurement and the uplink transmission is assumed to be 4 timeslots.

Outer-loop power control is disabled.

A.9 HSDPA Services

The following assumptions apply specifically to the HSDPA bearer services:-

?? Chase combining is assumed for all six fixed-rate reference channels. However, actual combining need not be simulated at the link level. It is assumed that the benefits of H-ARQ using Chase combining are incorporated within the system level simulation. Incremental redundancy is not simulated at the link or system level.

?? There are no detection errors made on the ACK/NACK field of the HS-SICH

?? There are no detection errors made on the HS-SCCH

A.10 Numerical Accuracy

Floating point accuracy is assumed throughout the simulation.

A.11 Output Metrics

Metrics are recorded during the simulations for each simulated propagation channel model in order to generate the following results of interest for the system level simulation activity.

A.11.1 Speech (12.2kbps) and Circuit Switched Data (384kbps) Bearer Services

1. Plots of mean $\frac{\hat{I}_{or}}{I_{oc}}$ versus DCH BLER

2. Plots of mean $\frac{\hat{I}_{or}}{I_{oc}}$ versus TFCI and TPC reliabilities

3. PDF of the Node-B and UE timeslot transmit powers when meeting 1% DCH BLER. These powers are expressed relative to I_{oc} and assume a mean pathloss of 0 dB.

4. Histogram of the short-term $\frac{\hat{I}_{or}}{I_{oc}}$ (averaged over each TTI transmission period) versus probability of transport block failure.

A.11.2 HSDPA Bearer Services

1. Plots of mean $\frac{\hat{I}_{or}}{I_{oc}}$ versus probability of HS-DSCH transport block failure for first-time transmissions.

2. Histogram of the short-term $\frac{\hat{I}_{or}}{I_{oc}}$ (averaged over each TTI transmission period – ie: 8 timeslots) versus probability of HS-DSCH transport block failure for first time transmissions.

Annex B (normative): System Level Simulation Assumptions

B.1 General

Given that system level simulation tools and platforms differ between companies, very detailed definition of system level simulation assumptions is not feasible. System level simulations may be performed in a dynamic manner or in a quasi-static manner. In either case, the link level simulation results from Annex A may be used as an input to the system level simulations.

This annex contains a set of basic assumptions and parameters allowing some harmonization of results.

B.2 System Level Parameters

B.2.1 Antenna Pattern

The antenna pattern used for each sector, is specified as :

$$A(\theta) = -\min\left[12\left(\frac{\theta}{\theta_{3dB}}\right)^2, A_m\right], \quad \text{where} \quad -180 \le \theta \le 180,$$

where min[ ] is the minimum function, θ_{3dB} is the 3dB beamwidth (corresponding to θ_{3dB} = 70 degrees) , and A_m= 20 dB is the maximum attenuation.

B.2.2 Antenna Orientation

The antenna bearing is defined as the angle between the main antenna lobe centre and a line directed due east given in degrees. The bearing angle increases in a clockwise direction. Figure B.1 shows an example of the 3-sector 120-degree center cell site, with Sector 1 bearing angle of 330 degrees. Figure B.2 shows the orientation of the center cell (target cell) hexagon and its three sectors corresponding to the antenna bearing orientation proposed for the simulations. The main antenna lobe centre directions each point to the sides of the hexagon. The main antenna lobe centre directions of the 18 surrounding cells shall be parallel to those of the centre cell. Figure B.2 also shows the orientation of the cells and sectors in the two tiers of cells surrounding the central cell.

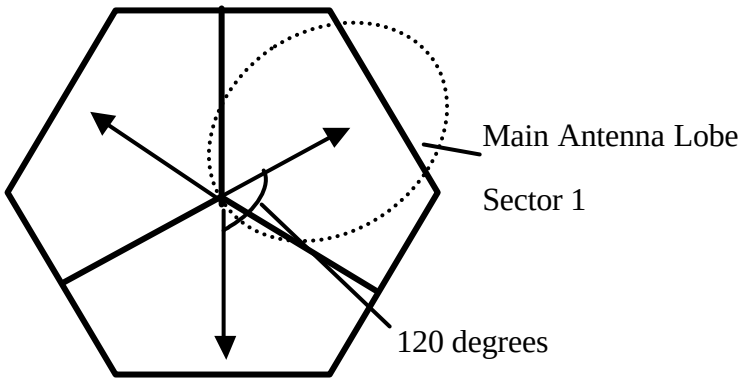

Figure B.1: Centre cell antenna bearing orientation diagram

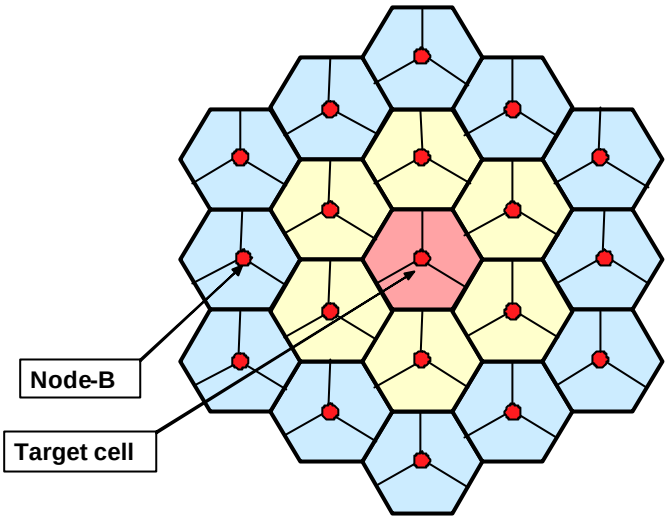

Figure B.2: Configuration of adjacent tiers of neighbouring cells, sectors, and Node-Bs

B.2.3 Common System Level Assumptions

The assumptions used in the system-level simulations that are common to Release 99/4 type and HSDPA type bearers are listed in Table B.1.

Table B.1 - Common system level simulation assumptions

Parameter	Explanation/Assumption	Comments
Cellular layout	Hexagonal grid, 3-sector sites	See Figure B.2
Antenna horizontal pattern	70 deg (-3 dB) with 20 dB front-to-back ratio	
Site to site distance	1000m	suburban deployment
Propagation model	$L = 128.1 + 37.6\ Log_{10}(R)$	R in kilometres
Slow fading	As modelled in UMTS 30.03, B 1.4.1.4	
Standard deviation of slow fading	8 dB	
Correlation between sectors	1.0	
Correlation between sites	0.5	
Correlation distance of slow fading	50 m	
BS antenna gain	14 dBi	
UE antenna gain	0 dBi	
UE noise figure	5 dB	
Thermal noise density	-174 dBm/Hz	
BS total Tx power	Up to 40 dBm	
BS noise figure	4 dB	
UE total transmit power	24dBm	
UE spatial distribution	Uniform random spatial distribution over elementary single cell hexagonal central Node-B	
Channel bandwidth	10MHz	
Frequency re-use	1	

It is assumed that the cells in the simulated configuration are synchronized such that all cells use the same timeslots for uplink and downlink and timeslot boundaries are synchronized in the network.

B.2.4 HSDPA specific simulation assumptions

The common system level assumptions of subclause 0 apply for HS-DSCH simulations. The system level assumptions that are specific to HS-DSCH channels are detailed in Table B.2.

Table B.2 - HS-DSCH specific system level simulation assumptions

Parameter	Explanation/Assumption	Comments
Power allocated to HS-DSCH in timeslot	100% of total cell power	
HSDPA TTI	10ms	
HARQ scheme	Chase combining	
Timeslot structure	according to Figure B.3.	
HS-SICH to HS-SCCH Node B turnaround	1 slot	
Feedback quality	Ideal	
HS-SCCH quality	Ideal	
CQI derivation	based on Ior_hat/Ioc in TTI	
Re-transmission priority	Maximum	
Scheduling	Proportional fair or round robin	
Maximum number of HARQ retransmissions	3	max 1 transmission and 3 re-transmissions per MAC-hs PDU

In the HS-DSCH system simulations, the scheduler shall schedule re-transmissions for UEs before it schedules initial transmissions to UEs. Re-transmissions are thus given the maximum priority by the scheduler.

The assumed frame structure for HSDPA related channels is shown in Figure B.3.

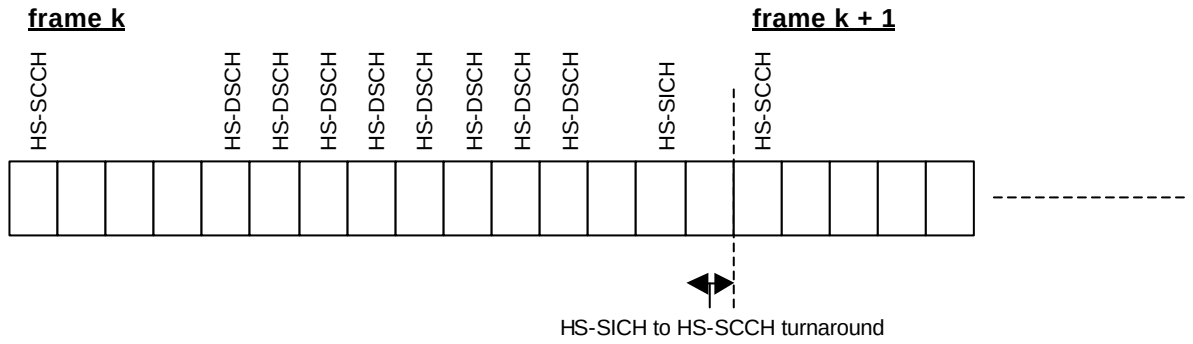

Figure B.3 - Frame structure for HS-DSCH system level simulations

B.2.4.1 Chase Combining assumptions

The Chase combining HARQ scheme shall be applied by the system simulator. A value $\left.\hat{I}_{or}/I_{oc}\right|_{comb}$ shall be maintained for each HARQ process of each UE in the system simulation. This value shall be reset to zero when the new data indicator bit is incremented for that UE. $\left.\hat{I}_{or}/I_{oc}\right|_{comb}$ shall be incremented by the amount $\left.\hat{I}_{or}/I_{oc}\right|_{inst}$ when there is a

(re)-transmission for that HARQ process (where $\left.\hat{I}_{or}/I_{oc}\right|_{inst}$ is an instantaneous value for the current TTI) . The probability of block error for the (re)-transmission is then read off the appropriate link level simulation curves for channel being simulated. This probability of block error is used to update the performance metrics.

Note that the method described here relates to symbol level Chase combining and allo ws the link level simulation results to be used to derive HARQ performance results.

B.2.4.2 CQI derivation assumptions

Following an HS-DSCH transmission, the system simulator shall derive a CQI for that UE based on the channel type, the $\left.\hat{I}_{or}/I_{oc}\right|_{inst}$ received by that UE, the link level simulation results and the BLER operating point for HS-DSCH. The system simulator shall base the MCS for retransmissions on the derived CQI value and may take account of the CQI value when scheduling UEs with HS-DSCH resources (according to the scheduler employed). For the purposes of scheduling, the system simulator may interpolate between the set of CQI values supported by the link level simulation results.

B.2.4.3 Size of allocations

The system simulator shall make HS-DSCH allocations with the code rates and modulations defined in Table A.8. The allocations shall span 8 timeslots. The number of codes in the allocation shall be an integer multiple of 2 (note that the link level results obtained in section A are derived using 4 code allocations, but are equally applicable to 2 code [and greater] allocations at the same code rate and modulation; at large transport block sizes, there is little variation in turbo decoder gain with transport block size). The performance of these allocations will be taken from the link level results as a function of code rate and modulation.

B.2.4.4 Scheduling Algorithms

Proportional fairness scheduling or round-robin scheduling may be applied. Other scheduling algorithms may be applied provided they are documented.

B.2.4.4.1 Proportional Fairness Scheduling

The proportional fairness (PF) scheduler shall be implemented as follows:

- At each time n, a priority function $P_i[n]$ is computed for each UE station i.
- The UE station i with the highest (largest) priority $P_i[n]$ is scheduled for the current time slot.

$P_i[n]$ is computed as follows:

$$P_i[n] = \frac{[DRR_i[n]]^{\alpha}}{[T_i[n]]^{\beta}}$$

where:

- n is the time (in TTIs)
- $DRR_i[n]$ is the data rate potentially achievable for UE station i at time n (computed using the CQI reported from the UE station). $DRR_i[n]$ is normalized to a 4 code, 8 timeslot allocation
- $T_i[n]$ is the average throughput served to this UE station up to time n
- α and β are indices used to control the scheduling fairness. The values normally used for simulation purposes here are $\alpha=\beta=1$. (Note that these two parameters can be varied to select a scheduling method anywhere between the two extremes of round-robin scheduling ($\alpha=0$, $\beta=1$) and maximum C/I scheduling ($\alpha=1$, $\beta=0$).)

$T_i[n]$ is computed as follows:

$$T_i[n] = \begin{cases} (1-\alpha)\,T_i[n-1] & \text{if MS } i \text{ was not scheduled at time } n\text{-}1 \\ (1-\alpha)\,T_i[n-1] + \alpha\,N_i[n-1] & \text{if MS } i \text{ was scheduled } N_i[n\text{-}1] \text{ info bits at time } n\text{-}1 \end{cases}$$

where $\alpha = 1 - \frac{10.0^{-3}}{1.5}$, which corresponds to an IIR averaging time constant of 1.5 seconds.

Note that $N_i[n-1]$ is the number of information bits (payload bits) corresponding to an initial packet transmission occurring at TTI *n-1*. It is updated *only once* for the first transmission of a new packet since net throughput (goodput) is the quantity of interest.

B.2.4.4.2 Round Robin Scheduling

A round-robin (RR) scheduler is defined as a scheduler that cyclically allocates a TTI to each one of the UEs in order to transmit data signals without consideration of the packet quality (successful transmission or not) or the current channel quality (whether or not the UE is currently in a fade).

B.3 Traffic Models

B.3.1 Release 99 / 4 type bearers

Calls are created according to a Poisson process as a function of the system load in Erlangs. The call duration is exponentially distributed with a mean of 120 seconds. The typical load offered per user during the busy period is 25 mErlang.

B.3.2 Release 5 type bearers

The system level simulation for the higher chip rate reference configuration shall consider the traffic models detailed in the following subclauses (B.3.2.1 and B.3.2.2). Only system level simulations with homogenous traffic mixes shall be considered (all users in the simulation with have solely HTTP traffic or solely FTP traffic). There is no mixing of traffic types within a simulation.

The models in sections B.3.2.1 and B.3.2.2 assume that all UEs dropped are in an active packet session. A packet session consists of multiple packet calls (where “packet call” is defined in sections B.3.2.1 and B.3.2.2 for HTTP and FTP traffic respectively).

B.3.2.1 HTTP Traffic Model Characteristics

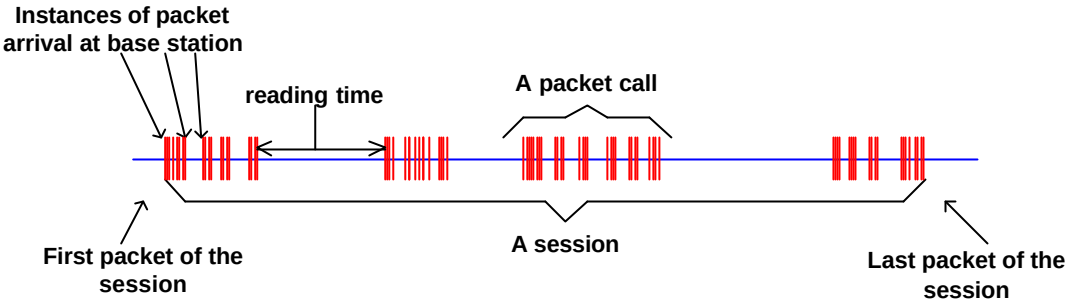

Figure B.4: Packet Trace of a Typical Web Browsing Session

Figure B.4 shows the packet trace of a typical web browsing session. The session is divided into ON/OFF periods representing web-page downloads and the intermediate reading times, where the web-page downloads are referred to as packet calls. These ON and OFF periods are a result of human interaction where the packet call represents a user's request for information and the reading time identifies the time required to digest the web-page.

As is well known, web-browsing traffic is self-similar. In other words, the traffic exhibits similar statistics on different timescales. Therefore, a packet call, like a packet session, is divided into ON/OFF periods as in Figure B.4. Unlike a packet session, the ON/OFF periods within a packet call are attributed to machine interaction rather than human interaction. A web-browser will begin serving a user's request by fetching the initial HTML page using an HTTP GET request. The retrieval of the initial page and each of the constituent *objects* is represented by ON period within the packet call while the parsing time and protocol overhead are represented by the OFF periods within a packet call. For simplicity, the term "page" will be used in this paper to refer to each packet call ON period.

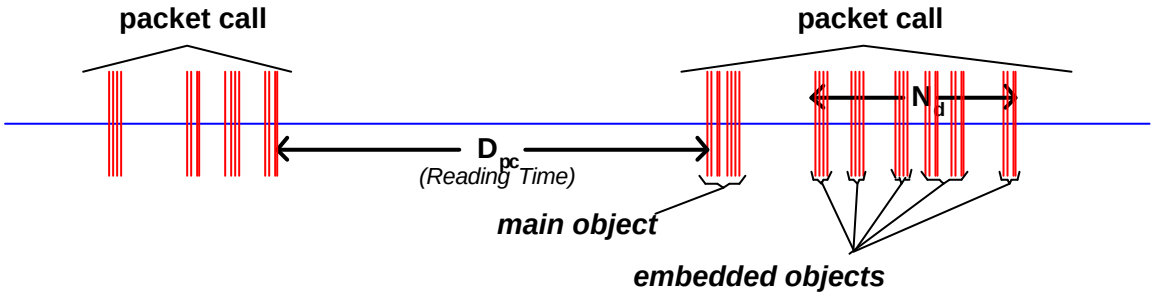

Figure B.5: Contents in a Packet Call

The parameters for the web browsing traffic are as follows:

- S_M: Size of the main object in a page
- S_E: Size of an embedded object in a page
- N_d: Number of embedded objects in a page
- D_{pc}: Reading time
- T_p: Parsing time for the main page

HTTP/1.1 persistent mode transfer is used to download the objects, which are located at the same server and the objects are transferred serially over a single TCP connection. The distributions of the parameters for the web browsing traffic model are described in Table B.3.

Table B.3: **HTTP Traffic Model Parameters**

Component	Distribution	Parameters	PDF
Main object size (S_M)	Truncated Lognormal	Mean = 10710 bytes Std. dev. = 25032 bytes Minimum = 100 bytes Maximum = 2 Mbytes	$f(x) = \frac{1}{\sqrt{2\pi}\sigma x}\exp\left(-\frac{(\ln x-\mu)^2}{2\sigma^2}\right), x > 0$ $\mu = 1.37, \sigma = 8.35$
Embedded object size (S_E)	Truncated Lognormal	Mean = 7758 bytes Std. dev. = 126168 bytes Minimum = 50 bytes Maximum = 2 Mbytes	$f(x) = \frac{1}{\sqrt{2\pi}\sigma x}\exp\left(-\frac{(\ln x-\mu)^2}{2\sigma^2}\right), x > 0$ $\mu = 2.36, \sigma = 6.17$
Number of embedded objects per page (N_d)	Truncated Pareto	Mean = 5.64 Max. = 53	$f(x) = \frac{\alpha k^\alpha}{\alpha-1}, k \le x \le m$ $f(x) = \left(\frac{k}{m}\right)^\alpha, x = m$ $\alpha = 1.1, k = 2, m = 55$ Note: Subtract k from the generated random value to obtain N_d
Reading time (D_{pc})	Exponential	Mean = 30 sec	$f(x) = \lambda e^{-\lambda x}, x > 0$ $\lambda = 0.033$
Parsing time (T_p)	Exponential	Mean = 0.13 sec	$f(x) = \lambda e^{-\lambda x}, x > 0$ $\lambda = 7.69$

B.3.2.2 FTP Traffic Model Characteristics

In FTP applications, a session consists of a sequence of file transfers, separated by *reading times*. The two main parameters of an FTP session are:

1. S : the size of a file to be transferred
2. D_{pc}: reading time, i.e., the time interval between end of download of the previous file and the user request for the next file.

The underlying transport protocol for FTP is TCP. The model of TCP connection described in Section B.3.2.1 will be used to model the FTP traffic. The packet trace of an FTP session is shown in Figure B.6.

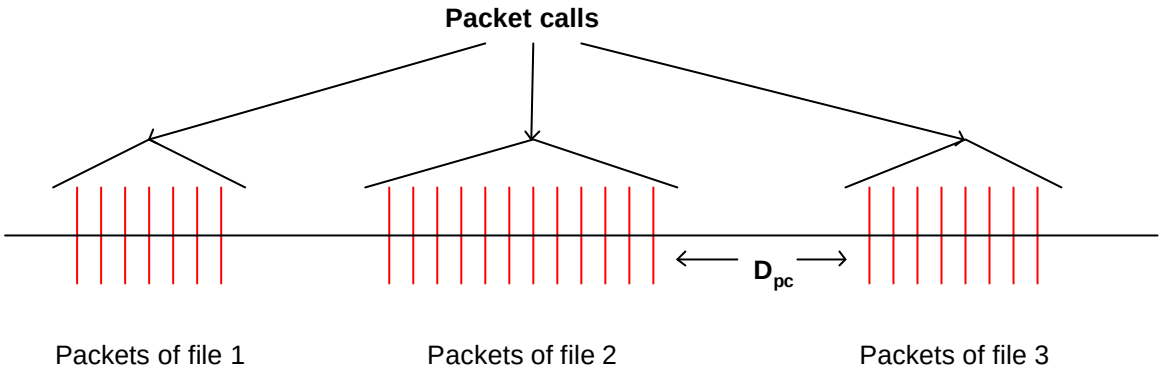

Figure B.6: Packet Trace in a Typical FTP Session

The parameters for the FTP application sessions are described in Table B.4.

Table B.4: FTP Traffic Model Parameters

Component	Distribution	Parameters	PDF
File size (S)	Truncated Lognormal	Mean = 2Mbytes Std. Dev. = 0.722 Mbytes Maximum = 5 Mbytes	$f_x ? \frac{1}{\sqrt{2??x}} \exp ?\frac{?\ln x ? ??^2}{2?^2}?, x ? 0$ $? ? 0.35, ? ? 14.45$
Reading time (D_{pc})	Exponential	Mean = 180 sec.	$f_x ? ? e^{??x}, x ? 0$ $? ? 0.006$

Based on the results on packet size distribution, 76% of the files are transferred using an MTU of 1500 bytes and 24% of the files are transferred using an MTU of 576 bytes. For each file transfer a new TCP connection is used whose initial congestion window size is 1 segment (i.e. MTU).

B.3.3 Channel Models

Simulations shall be performed with a mix of channel models within the cell. When a mix of channel models are applied within a cell, UEs shall be randomly assigned channel types with the probabilities defined in Table B.5.

Table B.5 – Probability distribution for assignment of channel models

Channel	probability
AWGN	0.2
ITU Ped A : 3kmph	0.3
ITU Ped B : 3kmph	0.3
ITU Veh A : 30kmph	0.15
ITU Veh A : 120kmph	0.05

Simulations may also be performed with a homogeneous channel model for the entire cell (the channel model for each UE in the cell shall be the same). In this case, results shall be derived for the channels models defined in annex A.

B.4 Output Metrics

B.4.1 Release 99 / 4 type bearers

B.4.1.1 Definitions

B.4.1.1.1 Satisfied User

A satisfied user for a circuit switched service is defined as follows :

1. the user is not blocked when arriving onto the system
2. over both directions of the entire call together, $BLER ? BLER_{threshold}$ for less than $x_1\%$ of the transport blocks.
3. the user's call is not dropped during the call. A call is dropped if, in either direction of a call, $BLER ? BLER_{threshold}$ in every TTI for more than t_{drop} seconds

B.4.1.1.2 System Load

The system load is measure in [kbps/cell]

The system load v_{cs} is derived as follows :

$v_{cs} ? ? _{cs} ? \text{user\_bitra te}$

where $? _{cs}$ is the average number of (simultaneous) circuit switched users per cell, i.e. the offered load (Erlangs)

B.4.1.1.3 Cell Operating Load

The cell operating load is defined as the system load where there are exactly x_2 % satisfied users.

B.4.1.1.4 Parameters definitions

The default values for the parameters defined in subclause 0 are defined in Table B.6.

Table B.6 - Parameter values definitions for CS system simulations

Parameter	Name / description	Value
x_1	Bad quality probability threshold	$x_1\% = 5\%$
$BLER_{threshold}$	Block error rate threshold for DPCH	1%
t_{drop}	Dropping time-out, circuit switched	5 seconds
x_2	Threshold for ratio of satisfied users	$x_2\% = 98\%$

B.4.1.2 Performance Metrics for Release 99/4 type bearers

System level performance metrics should be derived using homogeneous bearer services (i.e. there should not be a mix of 12.2kbps and 384kbps bearer services in the cell). Performance metrics shall be collected for the centre cell only of the hexagonal grid of cells defined in subclause 0.

The following performance metrics are defined :

1. **Blocking probability** is the probability that a user is not allowed onto the system. Graphs of blocking probability against system load shall be plotted.

2. **Number of satisfied users** is defined as the number of satisfied users in a cell where a "satisfied user" is defined in subclause **Error! Reference source not found.** (this metric takes account of call blocking, call dropping and call quality). Graphs of number of satisfied users against system load shall be plotted.

The cell operating load may be stated as a summary of the performance.

B.4.2 Release 5 type bearers

The following statistics related to data traffic should be generated. Separate sets of statistics should be collected as the number of UEs per cell is varied.

The following statistics related to data traffic should be generated as system level simulation results.

1. **Average cell throughput [kbps/cell]** is used to study the network throughput performance, and is measured as

$$R = \frac{b}{T}$$

   where b is the total number of correctly received data bits in all data UEs in the simulated system over the whole simulated time and T is the simulated time.

   The average cell throughput is calculated for the centre cell site only (consisting of 3 sectors).

2. **Average packet call throughput [kbps]** for user i is defined as

$$R_{pktcall}(i) = \frac{1}{K}\sum_{k=1}^{K}\frac{\text{good bits in packet call k}}{(t_{end\_k} - t_{arrival\_k})}$$

   where k denotes the k^{th} packet call from a group of K packet calls where the K packet calls can be for a given user i , $t_{arrival\_k}$ = time that first packet of packet call k arrives in queue, and t_{end_k} = time that last packet of packet k is received by the UE. Note for uncompleted packet calls, t_{end_k} is set to simulation end time. The mean, standard deviation, and distribution of this statistic are to be provided. The term "packet call" is defined in Figure B.5 for HTTP traffic and Figure B.6 for FTP traffic.

3. **The averaged packet delay per sector** is defined as the ratio of the accumulated delay for all packets for all UEs received by the sector and the total number of packets. The delay for an individual packet is defined as the time between when the packet enters the queue at the transmitter and the time when the packet is received

successfully by the UE. If a packet is not successfully delivered by the end of a run, its ending time is the end of the run.

4. **Number of satisfied users**
   A user is considered to be satisfied if an average of less than x_3 % of their MAC-hs PDUs cause an RLC retransmission due to the maximum number of HARQ retransmissions being exceeded.

Parameter values that shall be applied for the performance metrics of Release 5 type bearers are specified in Table B.7.

Table B.7 – Parameter values for performance metrics of Release 5 type bearers

Parameter	Name / description	Value
x_3	Threshold ratio of MAC-hs PDUs that cause an RLC retransmission	x_3 % = 0.01%

Annex C (informative):

Change History

Change history							
Date	**TSG #**	**TSG Doc.**	**CR**	**Rev**	**Subject/Comment**	**Old**	**New**
2002-10	RAN1#28 bis				Initial draft presented for discussion		0.0.0
2002-11	RAN1#29				Updated based on comments received in RAN1#28bis	0.0.0	0.0.1
2003-01	RAN1#30				Updated based on approved Tdocs in RAN1#29.	0.0.1	0.1.0
2003-02	RAN1#31				Updated based on approved Tdocs in RAN1#30	0.1.0	0.2.0
2003-02	RAN1#31				Updated based on approved Tdocs and comments in RAN1#31	0.2.0	0.2.1
2003-03	RAN#19				Version updated to v1.0.0 for presentation to RAN	v0.2.1	v1.0.0